311 Stanford Avenue
Menlo Park, CA 94025
October 16th, 1981

Dear Packet Radio Enthusiast,

Thanks very much for the letter of inquiry which you sent me. The response I've received to the initial publicity about the packet repeater has been very enthusiastic, and I have been deluged with requests from hams, both locally and from various points around the country, for more information about the repeater, for schematics, for listings, specifications, modems, proms, HDLC chips, Vancouver boards, and for talks at clubs. Needless to say, all this activity, plus continuing development on the packet hardware and software, has kept me very busy, and I apologize for any delay in responding to your letter. Let me bring you up to date on what has happened, or is happening, since the initial announcement of the repeater, which went on the air in December of 1980.

In the early months of this year, the packet repeater was operating out of my residence, and was still an experimental machine. Since then, we have installed a couple of upgrades to the control software, we have used a better CPU card, increased the power level, moved the repeater to 700 feet elevation, and integrated its operation to be 100% compatible with the protocol used by the Vancouver Digital Communications Group (VADCG). The repeater has changed from being a laboratory curiosity to a major Bay Area repeater heard from Berkeley to south San Jose, and the user community has grown from a couple of stations to a network of some 30 users. The packet system here now has a mailbox on-line 24 hours a day, several on-line personal computers, and network links (courtesy of a commercial packet network) to the other active packet radio centers in Washington, Vancouver and Ottawa. We have also just installed an HF port on 20 Meters, and are beginning some experiments aimed at establishing a connection with AMRAD in Washington and with equipment located at W1AW.

Most of the original packet radio experiments were done in Canada (in part due to the Canadians' pioneering communications spirit, and in part due to less restrictive regulations up there), and three main centers were at work: Montreal, Ottawa and Vancouver. The technology employed by each of these groups differed, and each approach has its own merits. My thinking and ideas very closely paralleled the work started by Doug Lockhart, VE7APU, and so I can best report on what is happening with groups which have adopted HDLC (High-level Data Link Control) framing as the basis of their protocol. The HDLC/SDLC frame is a new, universally accepted standard in the data communications industry, and Doug and I feel it offers a good starting point on which to build a packet-radio network. As it turns out, groups in Washington D.C., Los Angeles, El Paso, Denver, Sacramento, Tuscon, and Hamilton have also taken up this technology, and it is likely that we already have a sufficient number of people using this technique that it will become the defacto standard in the amateur radio community.

It would be impossible for me to completely describe the protocol and equipment being used in this letter, so I will briefly cover some of the topics and give you some pointers on where to find additional information. As you

311 Sunset Avenue
Menlo Park, CA 94025
October 16th, 1981

Dear Packet Radio Enthusiast,

might guess, this is a new area for amateur radio, and tutorial material and handbooks are not easily found. Many issues and problems remain to be discussed, and there is opportunity to make substantial contributions to the state of the art.

The Protocol - The basis for our technology is the HDLC frame, which is simply a way of encapsulating a series of bits into a message block. This type of message framing offers a high degree of error detection, data transparency, NRZI encoding, and a comprehensive set of standards for its use in a point-to-point protocol. Source documents for HDLC/SDLC and protocol are the following:

IBM Synchronous Data Link Control, General Information, GA27-3093

This manual is available through your company's IBM comp center or over-the-counter at most major IBM offices.

Advanced Data Communications Control Procedures, ANSI X3.66-1979

This is the American standard or HDLC. Write ANSI, 1430 Broadway New York, New York, 10018 for current price information.

For easier to get references, most recent books on data communications have chapters on "bit-oriented-protocols". These are some sources available:

IEEE Transactions on Communications, COM-28 No. 4, April 1980 (Special issue on Computer Network Architectures and Protocols)

IEEE Proceedings, Vol. 66, No. 11, pp 1301-1588, November 1978 (Special issue on Packet Communications Networks)

Technical Aspects of Data Communications by John E. McNamara, Digital Press (See Chapter 19 on Bit Oriented Protocols)

Communications Architecture for Distributed Systems by R.J. Cypser, Addison Wesley (See Chapter 11 on Data Link Control)

NCC (National Computer Conference) Proceedings, 1975, AFIPS Press (Many excellent articles on packet radio concepts)

Doug Lockhart's initial implementation of the protocol is a subset of the IBM SDLC standard. The enclosed notes document the type of frames used.

HDLC Chips - Quite a few manufacturers are now making HDLC/SDLC VLSI chips. Of the half-dozen or so available, only two have all the hardware required for easy use in an amateur radio environment. The special features required are NRZI encoding and an on-board digital phase-locked loop for timing recovery. The two chips which have been used by amateurs are the Intel 8273 and the Western Digital 1933. The Intel component data sheet has a brief summary of HDLC framing. In quantity purchase the Intel part is about $35, and the Western Digital part is $30.

Repeater Hardware - The repeater hardware is based on STD bus cards. The STD bus uses 56-pin 4 1/2" x 6 1/2" cards and is very popular for industrial process control applications. There are now many manufacturers supplying cards for this bus, and the repeater uses the Z-80/CPU-2 card from Mostek, which

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costs about $195. There is no reason why S-100 Z80 cards could not be used for a repeater. The STD card is very compact, and does not have unneeded extra circuitry which is typically found on more versatile personal system CPU cards. A WD1933 chip was breadboarded onto a Vector STD board, and one additional card to control the transmitter is all that was required. The software, written in PASCAL/Z and assembler fits into two 2716 EPROMS, and 2K bytes of RAM memory is required. The repeater can store up to 8 128-byte packets. The software and schematics will be available from me for a fee. Write or call if you are seriously interested in duplicating this equipment. The radio is an FT202 handheld transceiver with a 20 Watt power amplifier. Since this repeater runs simplex, problems associated with full-duplex repeaters (desense, etc.) are not encountered, and exotic remedies, such as duplexers, dual antennas, and so forth, are not required.

The repeater serves to increase geographic range due to its advantageous location, it digitally regenerates the packet, providing all stations with a uniform signal, it selectively repeats only those packets addressed to it, allowing the possibility of multiple repeaters on the same frequency (an advantage instead of a curse!), and its beacon and packet-repeat facilities allow stations to do full-loopback testing, an invaluable resource in bringing up new equipment and checking out hardware/software modifications.

The VADCG Terminal Node Controller - Doug's group designed a low cost, 8085 based circuit board which uses the Intel 8273, and which has proven to be a very easy way to get started in packet radio. The hardware/software does an excellent job and many are in use here in SF. Most people ask "Why can't I put this software onto my personal computer?" First, HDLC I/O interfaces are not commonly found on personal computers. Next, the VADCG TNC acts as a dedicated peripheral controller, handling the radio link protocol, and thus off-loads this responsibility from the home system. The personal computer can go off reading/writing its disks while packets are coming in over the air. Handling two full-duplex I/O paths at high speeds is a non-trivial programming job and is above the skill level of many amateurs. The current program is about 30 pages of assembly language, and is not particularly easy to transport to other 8080/Z80 environments because of the interrupt handling required. We have managed to support a wide variety of different home systems with one software package, and an upgrade to the program requires replacing some EPROMs, not rewriting the software for 30 different DOS's. Thus, for newcomers I would highly recommend buying a pair of TNC's, as the cost of the bare board is only about $35. Total cost fully loaded is around $200. The software is available from several sources around the country. The TNC could also be programmed to be a packet repeater, with relatively simple modifications to the existing code.

Modems - The Bell 202 modem is a voice frequency 1200 bits-per-second modem which is ideal for radio work at 2 meters and which can now be found at reasonable prices through various surplus outlets, or which can be fabricated using EXAR chips or op-amps. This modem has become standard for amateur radio use at this Baud rate. At one time I had a good supply of these modems for $75-$90, but I'm totally sold out at present. There are as yet no standards for higher speeds or direct digital modulation of an RF carrier. This is an area which needs more experimentation.

Newsletters - Our group does not have a newsletter. However, the following organizations periodically publish very fine newsletters which deal with packet radio:

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in 2025 with funding from
University of Maryland, Baltimore, Health Sciences and Human Services Library

https://archive.org/details/packet-repeat-info

AMRAD, 1524 Springvale Avenue, McLean VA 22101

VADCG, 818 Rondeau Street, Coquitlam, B.C., Canada, V3J 5Z3

Hamilton Area Packet Net, Stu Beal, Editor, 2391 Arnold Crescent, Burlington, Ontario, Canada, L7P 4J2

Reference Material - Some recent articles and publications have addressed themselves specifically to packet radio in an amateur radio environment:

Borden and Rinaldo, "The Making of an Amateur Packet-Radio Network", QST, Volume LXV No. 10, October, 1981, pp. 28-30.

Rouleau and Hodgson, "Packet Radio", TAB Books, Blue Ridge Summit, PA, ISBN 0-8306-1345-5, June 1981

Proceedings of the ARRL Amateur Radio Computer Networking Conference, Volumes I & II, October 16-17, 1981. Write AMRAD or ARRL.

Networking - Most active packet users agree that the real driving force behind packet is the ability to interconnect geographical areas through networks. Electronic mail, digitized imagery, networking games, computer conferences and other unthought of applications remain to be explored. The next year should bring some heavy-duty activity in the areas of defining network protocols and standards, and maybe even some interconnection between a few of the centers of packet radio activity. A conference to discuss these issues was recently held in Gaithersburg, Md., and from the number of people in attendance, and from the variety and depth of papers presented, it seems to me that a major new area in amateur radio has been opened.

Thanks again for your interest. See you on the net.

Best regards,

Hank

Hank Magnuski, KA6M

AMRAD, 1524 Springvale Avenue, McLean VA 22101

VADCG, 818 Rondeau Street, Coquitlam, B.C., Canada, V3J 5Z3

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